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FOR

A METHOD AND AN APPARATUS FOR THE INTEGRATION OF IP DEVICES INTO A HAVI NETWORK

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A METHOD AND AN APPARATUS FOR THE INTEGRATION OF IP DEVICES INTO A HAVI NETWORK

[0001] This application claims the benefit of the filing date of the following Provisional U.S. Patent Application:

"METHOD AND APPARATUS FOR THE INTEGRATION OF IP DEVICES INTO A HAVI NETWORK", application number 60256,134, filed December 13, 2000.

FIELD OF THE INVENTION

[0002] The present invention relates generally to HAVi networks and, more particularly, to a method and an apparatus for integrating IP devices into a HAVi Network.

BACKGROUND OF THE INVENTION

[0003] HAVi, home audio/video initiative, is a digital audio visual (AV) networking initiative that provides a home networking software specification for seamless interoperability among home entertainment products. The HAVi specification actually defines a set of criteria that enables compliant AV devices to interoperate in a home network. The specification lays down application program interfaces, APIs, which can be used by programmers to build applications that run on such networks, controlling devices irrespective of vendor or specific model characteristics.

[0004] Typically, a home audiovisual system will include a number of devices. Examples of such devices are televisions, radios, CD players, a pair of speakers, VCRs,

DVD players, etc. Many of these devices may be produced by different manufacturers and function independently of the other AV devices owned by a user. The HAVi network allows interoperability between these devices. As each device becomes known to the HAVi network, it is added to the HAVi networking system. Each appliance is automatically registered by HAVi so that other devices know what it is capable of. Since HAVi has standardized the APIs of the most common AV functions, this interoperability is possible.

[0005] For example, a VCR integrated into the HAVi network can search for an appliance that offers a clock with the time-of-day also on the HAVi network, and automatically set its own timers. This may be done with the HAVi network without the aid of a home personal computer (PC).

[0006] The interconnection medium used in a HAVi network is IEEE 1394. The IEEE 1394 serial communication bus standard (1394) is used as a local bus platform to provide the common messaging system. It carries commands and status information as well as digital audio and digital video signals between devices. Generally, 1394 has been a good interconnection medium because it has more than enough capacity to simultaneously carry multiple digital audio and video streams around the house. Also, 1394 provides support for digital copy protection.

[0007] While IEEE 1394 enables HAVi systems to offer guaranteed high levels of service, it restricts the range of devices that can participate in the home network. Generally, electronic devices made for home entertainment purposes are becoming more and more complex and with greater capabilities. This is in direct correlation with the continuing

emergence of a wide range of low cost, high-quality wired and wireless networks and end-systems. Many of these devices are considered a part of the home AV network but do not support 1394 connections. Instead, these devices usually support Internet Protocol (IP) on a wide range of wired/wireless networks such as the Internet. Examples of such devices are personal digital assistants (PDAs) oriented to home audio visual (AV) and MP3 players such as a MusicClip™ player manufactured by Sony Corporation.

[0008] Consumers are also increasingly purchasing such devices. As they purchase these devices, the HAVi network should allow these devices to be connected to the HAVi network regardless of a lack of 1394 support.

[0009] Currently, the HAVi specification accommodates the connection of non-1394 devices as extensions to 1394 devices when connected. The DCM for a hosting device is extended with the connected device functionality. However, this approach does not extend the HAVi network to IP devices. Also, it does not support running HAVi applications on IP devices.

[0010] One approach to integrate IP devices into the HAVi network may be to reengineer or rewrite the HAVi specification to integrate internet protocol devices into the HAVi network. Wholesale changes in the HAVi specification, however, may be costly and inefficient. Therefore, what is needed is a fairly cost-efficient method and apparatus for integrating IP devices into a HAVi network.

SUMMARY OF THE INVENTION

[0010] Accordingly, the present invention is a method and an apparatus for integrating IP devices into a HAVi network. An Internet Protocol (IP) and HAVi compliant device acts as a controller in the HAVi network and communicates with at least one HAVi compliant device using HAVi application programming interfaces (APIs). A server on the controller communicates with at least one IP device having a proxy and an IP and HAVi API. The server includes at least one IP device device control module (IP device DCM) corresponding to the IP device. The IP device providing API support to translate and relay calls between the proxy and the server so that at least one HAVi compliant device can communicate with the IP device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The present invention is illustrated by way of example, and not limitation, in the figures of the accompanying drawings in which:

[0012] **Figure 1** illustrates a single FAV cluster HAVi network in accordance with one embodiment of the invention;

[0013] **Figure 2** illustrates a block diagram of one embodiment of an IP device integrated into a HAVi network;

[0014] **Figure 3** illustrates a logical diagram of one embodiment of the client side architecture on an IP device;

[0015] **Figure 4** illustrates a logical diagram of one embodiment of the server side architecture of a HAVi Network;

[0016] **Figure 5** illustrates a flow diagram of a process of integrating an IP device into a HAVi network in accordance with one embodiment of the invention; and

[0017] **Figure 6** illustrates a flow diagram of a process of integrating an IP device into a HAVi network in accordance with another embodiment of the invention.

DETAILED DESCRIPTION

[0018] A method and an apparatus for integrating an Internet Protocol (IP) device into a home audio/video initiative (HAVi) are disclosed. Reference will now be made in detail to the embodiments of the invention, examples of which are illustrated in the accompanying drawings. While the invention will be described in conjunction with numerous embodiments, it will be understood that they are not intended to limit the invention to these embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the claims.

[0019] The present invention provides a method and apparatus for integrating an internet protocol (IP) device into a home audio/visual initiative (HAVi) network. The system includes a HAVi network with a plurality of devices connected to the HAVi network via a IEEE 1394 bus. A number of internet protocol devices are communicating and operating with the HAVi network via an IP protocol.

[0020] The HAVi network has been used increasingly to provide seamless interoperability between home AV devices. The underlying structure includes a set of interconnected clusters of appliances. Each cluster will work as a set of interconnected

devices to provide a set of services to users. Often, one device will act as a controller for a set of other devices. However, a controller is not required for HAVi to operate.

[0021] Generally, the interoperability model in HAVi provides (1) support for existing devices; (2) a default control model; (3) means to extend the default control model when new devices or functionality are brought to market; and (4) a common means for device representation. To achieve the above, the HAVi architecture defines three types of nodes in the home network: Full AV nodes (FAV), Intermediate AV nodes (IAV) and Base AV nodes (BAV). Further detail about the HAVi network including the notation and nomenclature, architecture overview, and system model of a HAVi network are described in U.S. Patent No. 6,085,236, filed on January 6, 1999, commonly assigned herewith and incorporated herein by reference.

[0022] In **Figure 1**, one embodiment of a HAVi network **100** is shown. The HAVi network **100** includes an FAV node **110** functioning as a controller. An FAV node is a device that contains a complete instance of the AV software model. This type of node generally has a richer set of resources and is capable of supporting a complex software environment. The primary distinguishing feature of an FAV node is that it is able to take control responsibility for less sophisticated devices and does this by loading a control module, usually from the less sophisticated device, and executing it locally.

[0023] In the embodiment shown in **Figure 1**, FAV node **110** acts as a controller for the HAVi network **100** and connected devices. Connected to the HAVi network **100** are several devices including a video camera **120**, a television **130**, a VCR **140**, and a CD player **150**. These devices are connected via a bus **124**. Generally, the bus **124** used to connect

devices to the HAVi network **100** is the IEEE 1394 bus standard. An IP device **160** is also integrated into the HAVi network **100** via an IP protocol **164**.

[0024] One example of an IP device that could be connected to the HAVi network is a personal digital assistant (PDA). Another example is an MP3 player such as a MusicClip™ player, manufactured by Sony Corporation. These devices would be considered home audio/visual devices in terms of the HAVi network. However, both of these devices do not have an IEEE 1394 bus connection and could not therefore normally participate in a HAVi network. The present invention allows IP devices such as these to participate in a HAVi network via an IP protocol.

[0025] The IP protocol may be implemented on a wireless connection or a wired connection. In one embodiment, the IP protocol may be implemented on a wireless connection such as an IEEE 802.11b connection. In another embodiment, the wireless connection may be a Bluetooth™. The IP networking protocol may also be a wired connection such as Ethernet. In other embodiments, the IP protocol may be implemented on fiber, optical, or cable networks.

[0026] In **Figure 2**, a block diagram of one embodiment of an IP device **230** integrated into a HAVi network **200** is shown. The HAVi network **200** includes an IP and HAVi compliant device, i.e., an FAV, acting as a controller **210**. The controller **210** runs a server **212** and includes HAVi software and APIs **214**. A HAVi compliant device **220** is shown to be included in the HAVi network **200** and coupled to the controller **210** via a 1394 bus **250**. In **Figure 2**, an IP device **230** has also been integrated into the HAVi network via an IP connection **240** to the controller **210**. The IP device **230** includes a set of proxies **234**

and IP and HAVi APIs **232**. In one embodiment, the proxies **234** and APIs **232** are downloaded onto the IP device **230** from the Internet. In an alternative embodiment, the proxies **234** and APIs **232** may be manually installed onto the IP device **230**.

[0027] In the embodiment shown in **Figure 2**, a (FAV or IAV) device acts as a controller **210** to access and control other HAVi compliant devices **220** and IP devices **230**. In an alternative embodiment, an IP device may control the FAV or IAV device as well as other HAVi compliant devices coupled to a HAVi network.

[0028] The set of proxies **234** communicate with the server **212** on the controller **210**. The server **212** acts as a proxy manager and accesses the HAVi software **214** to relay HAVi related information to the IP device **230**. The IP device **230** accesses a HAVi compliant device **220** by running a HAVi application on the IP device **230** using the IP and HAVi APIs **232**. In an alternative embodiment, a HAVi compliant device **220** accesses the IP device **230** by sending commands to an IP device control module (IP DCM) on the controller **210** that corresponds to the IP device **230**. The IP DCM is a logical representation of the IP device **230** that provides an API used to send control commands to the IP device **230** by the server **212** on the controller **210**. The IP device **230** has IP and HAVi APIs **232** that provide API support to translate and relay calls between the server **212** and the IP device **230**. The HAVi compliant devices **220** communicate with the server **210** by using HAVi APIs **222** and communicating via a communication medium such as the IEEE 1394 network.

[0029] In **Figure 3**, one embodiment of the client side architecture of an IP device **310** is shown. The IP device **310** implements TCP/IP protocols **320**. This is the format by which the IP device **310** communicates with other devices coupled to the HAVi network.

The IP device **310** also includes an application program interface (API) **336** that allows the IP device **310** to translate and relay calls to and from devices coupled to the HAVi network. The APIs **336** assists IP devices in hosting HAVi applications **340**.

[0030] In different embodiments, the APIs **336** have a library of functions. In one embodiment, the API **336** may include C++ HAVi/IP APIs. In another embodiment, the API **336** may include Java HAVi APIs. These libraries take care of packaging a command and sending the command to the server, i.e., setting up a stream. However, these libraries do not deal with the actual content of the stream. In one embodiment, JMF and C++ graphic libraries are used in conjunction with the above-mentioned libraries and a streaming module to get the stream data and display the stream data.

[0031] The IP device **310** also has appreciable code to support discovery protocols **332**, a messaging system **334**, and streaming protocols **338** that allow the IP device **310** to communicate and operate within the HAVi network. The discovery protocols **332** search and determine whether the IP device is coupled to a HAVi network. The messaging system **334** configures and packages any messages that are sent out from the IP device **310** to other devices coupled to the HAVi network as well as receiving any messages sent to the IP device **310**. In addition, the messaging system **334** enables the IP device **310** to communicate with devices coupled to the HAVi network to let them know that the IP device **310** is coupled to the HAVi network. **Figure 3** also shows a device manager **342** that is linked with and may be controlled by an IP DCM on a controller device. The device manager **342** receives commands from the HAVi network and accesses hardware, i.e., display a video or access a filed stored locally. In one embodiment, combining the device

manager **342** with the streaming protocols **338** allows a video from a HAVi device to be displayed on the IP device **310**.

[0032] **Figure 4** also shows the messaging system **416** and the discovery protocols **418** on the server side architecture. Referring to **Figure 4**, one embodiment of the server side architecture of a HAVi network is shown. In this embodiment, the server side architecture as shown is on an FAV device. The FAV device acts as a controller for the HAVi network **400**. From the server side, the FAV device implements discovery code to seek and find devices coupled to the HAVi network **400**. A server **420** receives messages from any devices connected to the HAVi network **400**. From HAVi compliant devices, messages are sent via an IEEE 1394 bus **430** to the server **420**. From IP devices, messages are sent via an IP. Any messages and information from the server stub **420** are pushed down into a HAVi stack **426**.

[0032] The HAVi stack **426** includes a device manager. As the FAV finds new devices coupled to the HAVi network **400**, the device manager creates a device control module for each new device. These device control modules (DCMs) **424** are instantiated for all the devices on the HAVi network **400**. The DCMs **424** allow the HAVi network **400** to interface with each HAVi compliant device and IP device DCMs **422** allow the HAVi network **400** to interface with each IP device. In this embodiment, the IP device DCMs **422** are instantiated independently of bus reset events. Bus reset, typically, occurs when any new HAVi compliant device is coupled to the HAVi network.

[0033] In the embodiments shown in both **Figure 3** and in **Figure 4**, the IP device can access audio and video content from the HAVi network. In **Figure 3**, streaming protocols **338** allow the IP device **310** to access audio and video content from the HAVi

network. In **Figure 4**, the streaming protocols **414** are also shown. In **Figure 4**, the server side architecture implements a stream bridge **428** which captures the audio and video content from devices coupled to the HAVi network **400** and relays that content to the IP device **410**. The IP device **410** via the streaming protocols **414** has the ability to use the audio and video content received from any device connected to the HAVi network **400**.

[0034] **Figure 5** shows a flow chart of a process **500** of integrating an IP device into a HAVi network in accordance with one embodiment of the present invention. First, at processing block **510**, an IP device is coupled to a first IP and HAVi compliant device acting as a controller through a connection using an IP. In one embodiment, this may be done automatically by the IP device using discovery protocols and a messaging system. In an alternative embodiment, the IP and HAVi compliant device may discover the IP device and automatically instantiate an IP DCM for the IP device. In yet another alternative embodiment, the user of the IP device may manually connect the IP device to the HAVi network. The IP device includes a proxy that communicates with a server on the controller.

[0035] At processing block **520**, an IP device DCM is instantiated on the controller to correspond to the IP device. The IP device DCM is a logical representation of the IP device that provides an API used to send control commands to the IP device by the controller. At processing block **530**, the IP and HAVi API and proxy on the IP device translate and relay information to the server on the first IP and HAVi complaint device. At processing block **540**, the coupling of the IP device to the IP and HAVi compliant device allows the IP and HAVi compliant device to communicate with the IP device using the IP DCM.

[0036] **Figure 6** shows a flow chart of a process **600** of integrating an IP device into a HAVi network in accordance with one embodiment of the present invention. First, at processing block **610**, an IP device is coupled to a first IP and HAVi compliant device acting as a controller through a connection using an IP. The IP device includes a proxy that communicates with a server on the controller.

[0037] At processing block **620**, an IP device DCM is instantiated on the controller to correspond to the IP device. The IP device DCM is a logical representation of the IP device that provides an API used to send control commands to the IP device by the controller. At processing block **630**, the IP and HAVi API and proxy on the IP device translate and relay information to the server on the first IP and HAVi complaint device. At processing block **640**, the coupling of the IP device to the IP and HAVi compliant device allows the IP and HAVi compliant device to communicate with the IP device using the IP DCM.

[0038] In one embodiment, as illustrated at processing block **640**, a second HAVI compliant device controls the IP device by accessing the IP device DCM. In an alternative embodiment, as illustrated at processing block **650**, the IP device controls a second HAVi compliant device by accessing the DCM corresponding to that device. In one embodiment, data is streamed between the IP device and the IP and HAVi compliant device at processing block **660**.

[0039] An example of this type of interaction is a PDA connected to the home network via a wireless connection including a Bluetooth™ connection. The PDA could run a host of applications such as acting as a remote controller that provides network-oriented

features far richer than those available with today's remote controllers. The PDA can integrate web based information since it has an AV display.

[0040] Another example of running HAVi applications on a personal digital assistant is transferring AV content between home and in-car AV devices. The PDA can also act as a portal for purchasing AV content for download to the user's HAVi network.

[0041] The present invention opens up any number of possible new uses for IP devices when integrated with a HAVi network. A method and apparatus for integrating an IP device into a HAVi network has been described. Although the present invention has been described with reference to specific embodiments, the specification and drawings are to be regarded as illustrative rather than restrictive.